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Identifying and Ranking the Factors Influencing Water Resource Consumption Management in Khuzestan Province: A Qualitative Approach

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A B S T R A C T

The objective of the present article is to identify and rank the factors influencing water resource consumption management in Khuzestan Province using a qualitative approach. Data collection was conducted through library research and fieldwork in the form of interviews. The research method employed was qualitative, carried out through interviews with experts. The study involved 20 participants, including specialists, university professors in the field of water management, and managers from organizations involved in water resource management within Khuzestan Province. (Considering theoretical saturation, participants were selected based on their sufficient expertise in water consumption management.) Data analysis was performed using MAXQDA software, version 22. According to the experts, seven main factors influencing water consumption management were identified. Each of these seven factors included several sub-factors or components. The first factor was the implementation of proper non-structural principles, within which 15 sub-factors related to water consumption management were identified. The second factor was the implementation of proper structural principles, which included 17 sub-factors. The third factor was public awareness and cultural promotion in consumption management, which encompassed 13 sub-factors. The fourth factor focused on consumption management in the domestic sector, with 13 associated sub-factors. The fifth factor pertained to consumption management in the industrial sector, with 11 identified sub-factors. The sixth factor related to organizational planning, which included 13 sub-factors. The seventh factor concerned consumption management in the agricultural sector, within which 32 sub-factors were identified. Based on expert prioritization, the ranking of the factors influencing water consumption management in the Khuzestan plain was as follows: (1) implementation of proper non-structural principles, (2) consumption management in the industrial sector, (3) implementation of proper structural principles, (4) consumption management in the agricultural sector, (5) public awareness and cultural promotion, (6) consumption management in the domestic sector, and (7) organizational planning. The results regarding the significance of these factors indicated that all variables affecting water consumption management were statistically significant at the 95% confidence level using the system dynamics approach. This model demonstrates that the factors extracted from expert interviews have a substantial impact on water consumption management.

Keywords: *Water, Water Resources, Consumption Management, Khuzestan Province, Qualitative Approach.*

1. Introduction

Water is a finite yet essential resource, critical to sustainable development, economic productivity, and social well-being. Effective management of water consumption, particularly in regions facing increasing demand and limited supply, has become a paramount concern in global and regional policymaking. Khuzestan Province, located in the southwest of Iran, exemplifies such a context where water scarcity, climate variability, and sectoral demand conflict intersect. Over the past decade, this province has experienced significant challenges due to both natural and anthropogenic pressures on its water resources, necessitating an urgent reevaluation of water consumption management strategies through a scientific and localized lens.

Modern water management requires an integrated, interdisciplinary, and systems-based approach that takes into account hydrological, environmental, social, economic, and political dimensions (Loucks, 2020). The shift from traditional supply-side water governance to demand-side management reflects the contemporary understanding that infrastructure alone cannot address the mounting pressures from population growth, industrial expansion, and climate stressors (Swain, 2018). Particularly in arid and semi-arid regions like Khuzestan, the sustainability of water systems depends on the effective integration of technological interventions, public awareness, legal mechanisms, and institutional planning (A. Mehrabi et al., 2022).

In Iran, although several national programs have been designed to address water challenges, implementation gaps remain, especially at the provincial level. The effectiveness of these policies often depends on localized knowledge, stakeholder engagement, and adaptability to regional hydrological patterns (Ahadzadeh et al., 2021). Khuzestan, which houses several major rivers and irrigation systems, also suffers from water mismanagement, pollution, inefficient consumption in agriculture and industry, and socio-political tensions over water access (Mirzaei et al., 2020). The situation is further complicated by reliance on both surface and groundwater resources, which are often managed in isolation rather than through an integrated framework (E. Mehrabi et al., 2022).

The agricultural sector in Khuzestan is a key driver of water consumption, yet it is plagued by outdated irrigation techniques, lack of crop pattern optimization, and minimal use of water-saving technologies (Barikani et al., 2019). Moreover, the over-extraction of groundwater and uncontrolled surface water diversion have led to a reduction in water table levels and deterioration in water quality (Chitsazian et al., 2021). Research indicates that integrated use of both surface and groundwater is essential to achieving efficiency and sustainability, particularly under conditions of water scarcity (Chen, 2022; A. Mehrabi et al., 2022). Failure to address these issues holistically has contributed to agricultural losses, rural outmigration, and intersectoral conflicts over water rights.

From a management standpoint, the adoption of non-structural principles, such as public education, pricing strategies, and regulation enforcement, is as vital as structural investments like dam construction, canal rehabilitation, and wastewater treatment systems (Barzegari Banadkouki et al., 2021; Weiss et al., 2022). In fact, studies show that behavioral interventions and institutional reforms often yield higher cost-benefit ratios than infrastructure-heavy projects (Weiss et al., 2022). However, in practice, institutional fragmentation, lack of data sharing, and limited coordination among stakeholders reduce the effectiveness of such interventions (Soleimani, 2019).

Urban and industrial water consumption in Khuzestan presents another layer of complexity. Rapid urbanization, outdated water distribution systems, and industrial effluents contribute significantly to resource stress and environmental degradation (Soltani & Zibaei, 2020). Industrial water demand is typically underestimated in regional planning models, and most industries lack wastewater recycling systems, exacerbating freshwater consumption and pollution loads (Klass, 2020). Furthermore, the management of urban stormwater, which could be harnessed as a supplemental resource, remains underdeveloped (Khoda Shenas & Tajbakhsh, 2021). Internationally, stormwater treatment systems have been shown to be cost-effective in urban settings, with substantial pollutant removal benefits when properly designed and maintained (Weiss et al., 2022).

Water pricing and economic tools are crucial in encouraging efficient consumption behavior, but their application in Khuzestan has been limited due to social resistance, political populism, and economic inequality (Barghi & Ghanbari, 2018; Rezaei & Abajelou, 2019). Effective demand management requires pricing schemes that reflect the true value of water while safeguarding access for vulnerable communities. International models have successfully combined volumetric pricing with block tariffs and subsidies to balance efficiency and equity (Cohen, 2018). Nevertheless, the implementation of such models in Iran is often hindered by regulatory inertia and lack of political will (Mazaheritehrani et al., 2023).

Another dimension requiring attention is environmental sustainability. The balance between water allocation for human use and ecosystem health is rarely maintained in current planning models. Studies emphasize the need for environmental flow policies to maintain biodiversity, support groundwater recharge, and prevent salinization and wetland degradation (Loucks, 2020; Soltani & Zibaei, 2020). In Khuzestan, the reduction of flow in rivers like Karun and Dez has not only endangered aquatic ecosystems but also diminished the quality of drinking water and increased the costs of water treatment (Mirzaei et al., 2020).

The geopolitical dimension cannot be ignored either. Khuzestan borders Iraq and shares transboundary water bodies whose management is subject to international negotiations. In the broader Middle East context, water is increasingly becoming a source of strategic competition (Cohen, 2018). Effective governance of shared water resources requires cooperation, transparency, and adherence to international law, as underscored in comparative studies of the Euphrates and Tigris river basins (Cohen, 2018; Klass, 2020).

The academic and policy literature thus suggests that effective water consumption management in Khuzestan must move beyond fragmented and reactive approaches toward integrated, forward-looking strategies. This entails a combination of robust scientific modeling, stakeholder inclusion, cultural change, and adaptive policymaking (Ahadzadeh et al., 2021; Mazaheritehrani et al., 2023). Participatory governance, in particular, is recognized as a vital enabler of legitimacy and compliance in resource management regimes (Khoda Shenas & Tajbakhsh, 2021). Capacity building for both governmental and non-governmental actors is essential to promote shared responsibility and transparency.

Furthermore, data-driven planning and spatial analysis tools can significantly improve resource allocation and monitoring. Open-source GIS platforms, for instance, have proven effective in mapping surface water availability, simulating demand scenarios, and identifying risk zones for intervention (Rezaei & Abajelou, 2019). In Khuzestan, such technologies could enhance the precision of planning and support decentralized decision-making.

Finally, research underscores the importance of resilience-oriented policies in dealing with future uncertainty. Climate change projections indicate increased variability in rainfall, higher temperatures, and more frequent extreme events in the region. These trends will further strain water availability, requiring flexible and adaptive planning mechanisms (Loucks, 2020; Swain, 2018). Tools such as scenario planning, system dynamics modeling, and real-time monitoring can support a transition toward adaptive governance in water systems (Chen, 2022; E. Mehrabi et al., 2022).

In summary, the complexity of water consumption management in Khuzestan Province calls for a multidimensional and integrated framework that leverages both scientific insights and local knowledge. Drawing from global best practices and grounded in regional realities, the present study seeks to identify, categorize, and prioritize the factors that influence water resource consumption in Khuzestan through a qualitative, expert-based approach.

2. Methods and Materials

Given the importance of water consumption in many countries and the critical need for water consumption management—particularly in Khuzestan Province—it was decided to conduct interviews with experienced experts and practitioners in this field to determine the effective factors in water resource consumption management in Khuzestan. Therefore, the research method applied in this study was qualitative, utilizing expert interviews. The participants consisted of 20 individuals, including experts (specialists, university professors in the field of water management, and managers) from organizations related to water resource management within Khuzestan Province. (Considering theoretical saturation for qualitative data collection), individuals were selected as the interview population based on their sufficient expertise in water consumption management.

The aim of sampling in qualitative methods is to understand the phenomenon under investigation. Accordingly, sampling in this qualitative study was purposive, since, unlike quantitative research, the goal is not to generalize findings to the population from which the sample is drawn but to understand the phenomenon in question. As mentioned, the researcher selected individuals with sufficient experience in water consumption management who could provide the most informative insights on the subject. Such individuals are referred to as "informational sources" and must be viewed as samples within a specific context.

In grounded theory research, data saturation determines the sample size. This means that during data analysis, when conceptual categories become fully developed and their interrelationships are well established, and no new codes emerge from the analysis, data saturation is deemed to have been achieved. Therefore, the sample size was equated with data saturation. In this approach, sample individuals are not referred to as "subjects" but rather as participants, informants, or collaborators.

This study is applied in terms of its objective, as the researcher aims to derive principles and rules applicable in real-world situations to improve practical methods. In terms of data collection and truth-seeking methods, it is descriptive-analytical in nature, and from a paradigmatic perspective, it is categorized as qualitative research.

In this study, interviews were conducted with 20 experts (specialists, university professors in the field of water management, and managers) from organizations related to water resource management in Khuzestan Province. The interviewees met at least one of the following two criteria: either they had research experience in water consumption management or had practical experience with water resources and their uses in various sectors—or were overall recognized authorities in the field. Additionally, during the course of the interviews, efforts were made to expand the list of participants based on interviewees' recommendations to enrich the quality of the study.

According to the principles of grounded theory, theoretical sampling continued until theoretical adequacy of the categories was achieved. The interviews lasted between thirty-five minutes to one hour. The audio of the interviews was recorded and immediately transcribed after completion.

To ensure the robustness of data in qualitative research, attention must be paid to credibility (acceptability), dependability, confirmability, and transferability. In this study, several criteria were used to verify the expertise of participants, including their experience in water consumption management, involvement in related research projects, or participation in executive projects in Khuzestan Province. The minimum educational requirement for interviewees was a master's degree. Additionally, their interest in participating in the research was considered, and all experts in this study were highly motivated to share valuable information on the topic. Data analysis was conducted using MAXQDA software, version 22.

3. Findings and Results

To identify and rank the factors influencing water resource consumption management in Khuzestan Province using a qualitative approach, interviews were conducted with 20 experts (specialists, university professors in the field of water management, and managers) from relevant organizations in the province. In-depth semi-structured interviews were conducted.

Table 1

Extracted Components from Interviews – Application of Proper Non-Structural Principles in Water Consumption Management (Khuzestan Province)

No.	Component
1	Precise adherence to water supply standards
2	Continuous monitoring and inspection of water supply networks
3	Public and local organization training in proper water usage
4	Specialized training for local/urban officials and community leaders
5	Balancing water supply and demand
6	Managing competition and resolving water-related conflicts
7	Pollution control of water sources

8	Coping with natural and social crises
9	Management of transboundary and interprovincial water resources
10	Public awareness and cultural promotion for responsible consumption
11	Implementing proper pricing mechanisms for water use
12	Reducing unnecessary losses and consumption
13	Measurement and metering of water consumption
14	Separation of potable water from water used for cleaning
15	Industrial water consumption management

Table 2

Extracted Components from Interviews – Application of Proper Structural Principles in Water Consumption Management (Khuzestan Province)

No.	Component
1	Application of advanced technologies in urban wastewater networks
2	Repair and rehabilitation of aging water supply networks
3	Pressure and leakage management in distribution systems
4	Controlling sedimentation in water pipelines
5	Use of appropriate wastewater treatment systems
6	Protective coverings for water tanks during dust storms
7	Detailed inspection of external and internal water pipelines
8	Collection of wastewater using separate drainage systems
9	Maintenance of surface water resource stations
10	Construction of concrete storage dams
11	Construction of diversion dams
12	Construction of rubber dams
13	Construction of channels and waterways
14	Separate drainage systems for stormwater and cleaning water
15	Accurate measurement of annual rainfall via advanced meteorological stations
16	Precise meteorological stations and weather forecasting
17	Computerized systems for water distribution across the province

Table 3

Extracted Components from Interviews – Awareness and Cultural Promotion in Water Consumption Management (Khuzestan Province)

No.	Component
1	Educating citizens on water scarcity
2	Use of local and national media to promote water-saving practices
3	Utilizing social networks for public awareness on the water crisis
4	Distribution of informational booklets to the public
5	Tariff incentives for low water consumption households
6	Managing potable water use in non-essential sectors (e.g., agriculture)
7	Promoting a culture of water conservation
8	Training on proper water usage and minimizing waste
9	Educating children to internalize responsible water consumption behaviors
10	Raising awareness on environmental degradation impacts
11	Producing media content on proper water consumption and broadcasting it widely
12	Government-led awareness campaigns through various media outlets
13	Government subsidies to support public access to water-saving devices

Table 4

Extracted Components from Interviews – Household Water Consumption Management (Khuzestan Province)

No.	Component
1	Use of drought-resistant plants suited to local climate
2	Leak detection in building plumbing and fittings
3	Reuse of gray water for irrigation and cleaning

4	Use of water-retaining irrigation gels
5	Proper installation of storage tanks and pumps to avoid direct tap pumping
6	Using dishwashers at full capacity
7	Reducing shower time to conserve water
8	Placing evaporative coolers in shaded areas
9	Avoiding open-hose car washing; prefer pressure nozzles or car washes
10	Avoiding traditional carpet washing at home; use professional carpet cleaning services
11	Avoiding hose-based sidewalk cleaning; prefer using brooms
12	Avoid defrosting frozen food with running water

Table 5

Extracted Components from Interviews – Industrial Water Consumption Management (Khuzestan Province)

No.	Component
1	Use of differentiated water pricing models in industry
2	Adoption of industrial water-saving techniques
3	Recycling of wastewater for industrial reuse
4	Use of cooling towers in industrial settings
5	Salinity-based water classification and appropriate use in industrial sectors
6	Measures for water conservation: leak detection, unauthorized connection control, reinforcement
7	Monitoring of water consumption in provincial industries
8	Industry participation in water labeling of manufactured products
9	Use of affordable electronic wastewater treatment systems
10	Installation of water meters for performance and efficiency monitoring

Table 6

Extracted Components from Interviews – Organizational Planning in Water Consumption Management (Khuzestan Province)

No.	Component
1	Water rationing policies and usage restrictions
2	Water pricing strategies including metering and tiered tariffs
3	Major research investments in industrial water management
4	Strategic goals for water efficiency in factories
5	Employee involvement in water-saving initiatives
6	Environmental cooperation agreements between agencies and industries
7	Establishment of river and water committees with equitable water distribution plans
8	Assessment of environmental, spatial, and socioeconomic impacts for new allocations
9	Cultural initiatives: water and environmental education centers by municipalities and schools
10	Irrigation system improvements: pipelines, accounting, engineering, and maintenance
11	Water allocation for environmental needs and sustainable development balance
12	Adoption of integrated water resource management strategies for the province
13	Reform and alignment of water property rights in the region

Table 7

Extracted Components from Interviews – Agricultural Water Consumption Management (Khuzestan Province)

No.	Component
1	Proper allocation of water across agriculture, domestic, industrial, and service sectors
2	Implementation of wastewater collection, treatment, and demand management projects
3	Watershed-level planning and regional analysis
4	Crop pattern changes in agriculture
5	Increasing yield per hectare
6	Reducing irrigated area to balance supply and demand
7	Water balance metrics (evapotranspiration, deep percolation, surface runoff, capillary rise)
8	Groundwater management
9	Conservation in agricultural well water use
10	Optimization of water allocation
11	Planning for return flow reuse

12	Inter-basin transfer and water flow regulation
13	Mechanisms to improve household water quality
14	Use of modern irrigation methods
15	Urban water management
16	Flood management
17	Physical land reform and leveling
18	Soil nutrition management to enhance water retention
19	Planting low-water crops with high economic value
20	Managing peak-hour water use through pricing and storage policies
21	Long-term allocation balancing supply and demand
22	Environmental protection and pollution control policies
23	Capital release in the water sector for consumer welfare
24	Establishing a comprehensive provincial water resource management system
25	Planning for natural and social crisis response
26	Management of transboundary and shared water resources
27	Enhancing extractable per capita water and improving water quality
28	Uniform spatial and temporal water distribution
29	Achieving water supply and demand balance
30	Efficient water use
31	Effective water pricing mechanisms
32	Reducing water loss in agriculture

To rank the identified components based on expert opinions and the degree of influence of each component, the significance level ($p < 0.05$) and the t-statistic were used. As shown in Table 8, all extracted components are statistically significant at a high level and above the average threshold.

Table 8

One-Sample t-Test Results Based on Expert Opinions

Row	Component	Mean	Std. Deviation	df	Sig. (p)	t
1	Application of proper non-structural principles	4.584	0.365	20	0.000	9.215
2	Industrial water consumption management	4.562	0.357	20	0.000	9.184
3	Application of proper structural principles	4.497	0.351	20	0.000	9.130
4	Agricultural water consumption management	4.382	0.367	20	0.000	8.528
5	Awareness and cultural promotion	4.257	0.372	20	0.000	7.784
6	Household water consumption management	4.239	0.385	20	0.000	5.923
7	Organizational planning	4.127	0.380	20	0.000	7.562

To determine the relationship between the factors affecting water consumption management and how they influence it, path analysis was employed.

Table 9

Model Fit Indicators for Confirmatory Factor Analysis

Test Name	Description	Acceptable Values	Obtained Value
χ^2/df	Relative Chi-square	< 3	2.107
RMSEA	Root Mean Square Error of Approximation	< 0.10	0.050
RMR	Root Mean Square Residual	< 0.10	0.095
GFI	Goodness of Fit Index	> 0.90	0.942
NFI	Normed Fit Index	> 0.90	0.954
CFI	Comparative Fit Index	> 0.90	0.924

The RMSEA value of 0.096 is less than 0.10, indicating that the model's mean square error is within an acceptable range, and thus the initial model is validated. The values of GFI, CFI, and NFI are all above 0.90, confirming that the measurement model for the sub-factors is suitable. Results from Table 9 also show that the mean differences are statistically significant. Since the critical ratio falls outside the range of ±1.96 and the significance level is less than 0.01, it is confirmed at the 99% confidence level that the sub-factors significantly influence water consumption management capacity.

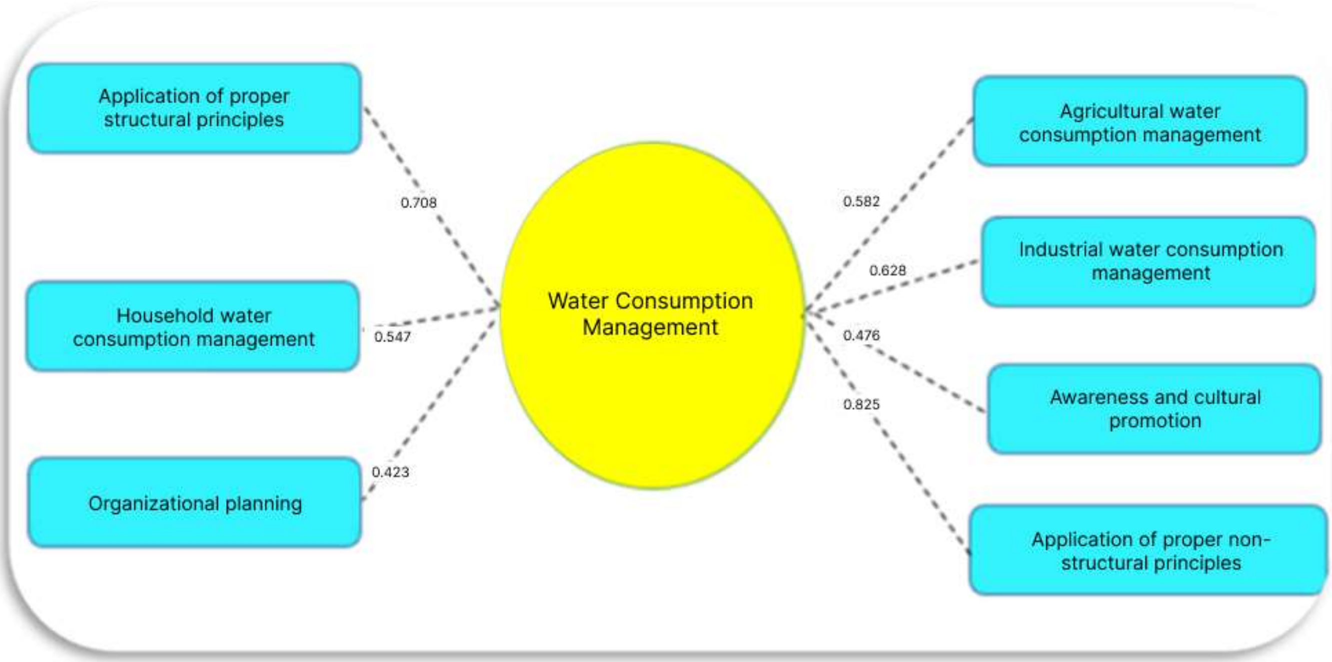
Table 10

Significance of Differences Between Factors Affecting Water Consumption Management

Factor	B	CR	t	Mean	Mean Difference	Sig. (p)
Industrial water consumption	0.582	2.62	3.6	3.12	0.39	0.000
Industrial water consumption	0.628	2.82	3.9	3.25	0.46	0.000
Awareness and cultural promotion	0.476	2.68	4.2	4.22	0.67	0.000
Application of non-structural principles	0.825	2.54	4.1	4.35	0.86	0.000
Application of structural principles	0.708	2.79	5.2	4.36	0.83	0.000
Household water consumption	0.547	2.52	6.2	3.12	0.72	0.000
Organizational planning	0.423	2.33	6.4	3.25	0.76	0.000

Figure 1

Structural Model of Factors Affecting Water Consumption Management in Khuzestan Province



Based on the results in Figure 1, since the p-value in the Jarque-Bera test exceeds 0.05 and the figure shows that the error terms maintain a bell-shaped curve, the null hypothesis of the test is not rejected. Therefore, the error terms in the model are normally distributed.

4. Discussion and Conclusion

The present study was conducted with the aim of identifying and ranking the key factors influencing water consumption management in Khuzestan Province using a qualitative methodology based on expert input. The results indicated that all seven primary dimensions—application of proper non-structural principles, industrial water consumption management, structural principles, agricultural consumption management, awareness and cultural promotion, household consumption, and organizational planning—were statistically significant ($p < 0.05$) and above average in expert evaluations. Among these, the application of proper non-structural principles was ranked as the most influential, followed by industrial consumption management and structural principles.

The prioritization of non-structural measures emphasizes the evolving understanding that effective water governance cannot rely solely on physical infrastructure. It must instead include social, behavioral, and regulatory mechanisms that shape demand-side efficiency (Loucks, 2020; Weiss et al., 2022). This is consistent with the findings of Barzegari Banadkouki et al., who argue that non-structural strategies such as education, institutional coordination, pricing mechanisms, and policy enforcement play a pivotal role in achieving sustainable water management outcomes (Barzegari Banadkouki et al., 2021). Additionally, mechanisms like monitoring, pollution control, and crisis preparedness, highlighted in this study, are in line with the recommendations of Swain, who emphasizes systemic resilience and risk reduction in arid and semi-arid regions (Swain, 2018).

The prominence of industrial water consumption management as the second most critical factor reflects the increasing strain placed by industry on provincial water resources. Participants highlighted the urgent need for wastewater recycling systems, salinity management, leakage detection, and economic incentives tailored to industrial users. These findings align with prior research, which suggests that most industries in developing contexts, including Iran, underutilize water reuse technologies and overexploit freshwater resources (Chen, 2022; Klass, 2020). Soltani and Zibaei also underscore the consequences of inefficient water use in industrial sectors and advocate for both technological reform and regulatory oversight to mitigate overconsumption and pollution (Soltani & Zibaei, 2020).

The third-ranked factor—application of proper structural principles—points to the need for continued investment in the physical infrastructure of water systems. Sub-factors such as repairing water pipelines, constructing diversion and rubber dams, and implementing metering technologies are consistent with infrastructure priorities identified in other Iranian contexts (Soleimani, 2019). Moreover, urban water resilience strategies, including stormwater collection and smart distribution systems, proposed by Khoda Shenas and Tajbakhsh, align with expert insights into Khuzestan's needs for urban adaptation and efficiency (Khoda Shenas & Tajbakhsh, 2021). Such structural improvements remain foundational in building the physical capacity of water systems, even as non-structural policies guide their operation.

Agricultural water management ranked fourth in priority, despite being the dominant consumer of water in Khuzestan. Experts emphasized changes in crop patterns, advanced irrigation methods, and reducing irrigated land as key strategies for improving efficiency. These recommendations align with empirical studies that demonstrate the impact of crop diversification and smart irrigation planning on reducing agricultural water demand (Barikani et al., 2019). Mehrabi et al. also stressed the necessity of integrating surface and groundwater resources to address the fragmentation in water supply systems in agricultural zones (A. Mehrabi et al., 2022). Rezaei and Abajelou have shown that decision-support systems and open-source GIS tools can assist in optimizing agricultural water allocations by providing real-time spatial data and analysis (Rezaei & Abajelou, 2019).

Awareness and cultural promotion were ranked fifth, but their significance is critical for sustainable behavioral change. This factor includes educating the public, utilizing traditional and social media, and incentivizing water conservation practices. Cultural engagement has been identified as a key determinant of water-saving behaviors, particularly in regions with entrenched consumption patterns (Mazaheritehrani et al., 2023). In the context of Khuzestan, where historical reliance on abundant water resources has shaped local behavior, building a new culture of conservation requires sustained educational and promotional efforts. Chitsazian et al. showed that increased public engagement and community-level dialogue lead to more responsible water behaviors and better local water governance outcomes (Chitsazian et al., 2021).

Household water management, ranked sixth, was considered less impactful compared to industrial and agricultural consumption but still essential in aggregate terms. Experts pointed to common practices like water recycling at the household level, use of efficient appliances, and awareness of behavioral habits. Loucks identifies urban residential consumption as a significant and under-addressed area of water planning in many global water strategies (Loucks, 2020). Demand-side tools such as progressive pricing, rebates, and conservation education have proven effective in managing residential water usage (E. Mehrabi et al., 2022). Additionally, Cohen suggests that urban domestic water use can be a gateway for broader public awareness campaigns and civic responsibility in water governance (Cohen, 2018).

Organizational planning was ranked lowest among the seven primary factors, yet it plays a strategic role in coordinating multisectoral water initiatives. Experts underscored the importance of integrated water resource management (IWRM), inter-organizational coordination, strategic goal-setting, and long-term planning. These findings reinforce arguments by Ahadzadeh et al., who demonstrate that the success of public water policy implementation in Iran depends largely on the alignment of institutional structures and the quality of inter-agency collaboration (Ahadzadeh et al., 2021). Similarly, Mazaheritehrani et al. highlight the role of green governance structures and regulatory integration in public sector water management (Mazaheritehrani et al., 2023).

The confirmatory model fit indices support the structural validity of the framework developed in this study. RMSEA, CFI, and GFI values all confirmed that the proposed seven-factor model adequately fits the empirical data. The significance of mean differences and the robustness of the critical ratios validate the prioritization results and indicate strong internal consistency among expert assessments. These findings align with earlier modeling efforts that emphasize the systemic nature of water resource management and the need for interconnected, adaptive planning mechanisms (A. Mehrabi et al., 2022).

Moreover, the comparative ranking offers useful insights for policymakers. The emphasis on non-structural and industrial strategies suggests that soft governance and industry reforms may yield faster and more sustainable outcomes than purely infrastructural projects. This is in agreement with international best practices that recommend beginning with behavioral change, stakeholder engagement, and regulatory enforcement to create enabling conditions for infrastructural investments (Cohen, 2018; Swain, 2018).

Overall, the study illustrates that sustainable water consumption management in Khuzestan cannot be addressed through fragmented or one-dimensional approaches. Rather, it requires a blend of structural improvements, behavioral change, institutional integration, and strategic foresight. Each factor, while individually important, gains effectiveness when embedded within a cohesive and adaptive management framework (Loucks, 2020; A. Mehrabi et al., 2022; Weiss et al., 2022). As such, future policies should aim to strengthen coordination among stakeholders, decentralize implementation to local institutions, and invest in continuous capacity building to embed sustainability into practice.

Despite its strengths, the study has several limitations. First, the qualitative approach, while rich in depth, limits the generalizability of findings beyond the specific context of Khuzestan. Second, the reliance on expert interviews, though methodologically justified, may have introduced selection bias, particularly in the overrepresentation or underrepresentation of certain institutional viewpoints. Third, the study focused primarily on managerial and strategic dimensions, potentially overlooking technical and hydrological variables that could further refine the model. Lastly, the cross-sectional nature of the research limits the ability to capture temporal variations in water consumption patterns or policy impacts.

Future studies should aim to incorporate mixed-methods approaches, combining qualitative insights with quantitative modeling and spatial analysis. Expanding the geographic scope to include other provinces would enhance the generalizability and comparative value of the findings. Longitudinal research could also capture the dynamic effects of implemented policies and shifts in public behavior over time. Additionally, future work should consider integrating climate projections, land-use changes, and demographic trends into water consumption modeling to support more resilient planning under uncertainty.

Practitioners should prioritize non-structural interventions such as public education, pricing reforms, and industrial regulation while concurrently investing in critical infrastructure upgrades. Integrated water resource management frameworks should be institutionalized at the provincial level, emphasizing inter-sectoral coordination and stakeholder participation. Moreover, decentralized planning mechanisms that engage local communities and industries can enhance compliance and innovation. Finally, efforts to promote a culture of water responsibility—particularly among youth and through mass media—can embed sustainable behaviors into daily practices, ensuring long-term impact.

Authors' Contributions

Authors contributed equally to this article.

Declaration

In order to correct and improve the academic writing of our paper, we have used the language model ChatGPT.

Transparency Statement

Data are available for research purposes upon reasonable request to the corresponding author.

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Ethics Considerations

In this research, ethical standards including obtaining informed consent, ensuring privacy and confidentiality were considered.

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